CHEMICAL EVOLUTION AND THE PRESERVATION OF ORGANIC COMPOUNDS ON MARS

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Several lines of evidence suggest that the environment on early Mars and early Earth were very similar.[1] Since life is abundant on Earth, it seems likely that conditions on early Earth were conducive to chemical evolution and the origin of life. The similarity between early Mars and early Earth encourages the hypothesis that chemical evolution might have also occurred on Mars, but that decreasing temperatures and the loss of its atmosphere brought evolution to a halt. The question then arises: Can one expect to find on Mars remnants of organic material dating back to this early clement period?

In an attempt to answer this question a literature search was undertaken ranging from organic geochemical studies to stability measurements of selected organic compounds. In many instances analysis of the organic content of ancient sediments has revealed the presence of minute amounts of hydrocarbons, fatty acids, amino acids and other organic material, most likely of biological origin. Even though it cannot be unequivocally demonstrated that the organic material found within the one billion years old cherts is syngenetic with the associated sediments,[2] stability studies in the laboratory indicate that amino acids and other biochemically interesting compounds could be quite stable over geological time scales.[3] Because of Mars' geological stability, the now prevailing lower temperatures and absence of liquid water, organic matter could have been preserved on Mars better than on Earth. Nevertheless, no organic material has been found on Mars to date.[4] The absence of organics on the Martian surface may well be accounted for by its extensive irradiation by UV, which would certainly destruct any organic compound present. Therefore, the absence of organic material on the surface does not preclude the presence of it deep inside the planet where UV radiation cannot reach. Accordingly, if chemical evolution leading to the formation of organic material had occurred on early Mars, traces of it should be found beneath the Martian surface.

Hence the discovery of any organic compound on Mars would be highly significant for Exobiology. On the other hand, if no organic compounds are found on Mars, this may force a reassessment of the theories of chemical evolution and the origin of life on Earth.[5] Therefore, extensive sampling and detailed analysis for organic constituents in selected sites beneath the Martian surface is a primary objective for Exobiology.

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